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NOTES REGARDING JUNIOR HIGH SCHOOL MATHEMATICS PROGRAMS

1971

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NOTES REGARDING JUNIOR HIGH SCHOOL MATHEMATICS PROGRAMS

1971

Philosophy of the Junior High School Mathematics Program

In developing the junior high school mathematics program, the committee proceeded on the basis of the following guidelines:

1. The course outlines found in the Junior High School Program of Studies indicate the topics which should be covered over a three-year period of junior high school.

2. The sequence of topics listed in the course outlines need not be followed. In fact, the use of some of the recommended texts will suggest considerable changes in the sequence. It is considered very desirable that students should treat all the topics in some manner during the junior high school period.

3. The textbooks recommended provide a variety of approaches and varying depths of treatment of specific topics. Teachers may find it very desirable to use different sources for presenting some topics, for practice material or as sources of supplementary or enrichment materials.

   It is suggested that teachers may find the teacher's editions valuable sources of information regarding:

   a) material that might be omitted for slow learners
   b) material that might be added for high ability students
   c) methods of presentation
   d) reference materials
   e) sources of manipulative materials.

4. The amount of time that might be spent on a specific topic must be decided by the teacher and will vary according to the needs and abilities of the class. If coverage in depth of a number of topics requires a substantial amount of time and therefore necessitates a substantial amount of homework by students, teachers should strongly consider reducing the depth of coverage of some of the topics.

5. An over-riding consideration on the part of teachers relative to the manner in which the course is treated should be the degree to which students are experiencing a feeling of success with the program involved. The purpose of identifying the junior high school mathematics program in the manner that has been carried forward is to provide teachers with the opportunity to achieve this objective. No particular text should be looked upon as the program of studies. Teachers who look upon a particular text as a program of studies will have difficulty completing the program in the time that is devoted to mathematics instruction in a given grade.

Recommended Texts

Recommended texts include the following:

Grade VII: *Contemporary Mathematics 1*, Hanwell et al.
Exploring Modern Mathematics, Book 1, Keedy et al.
Mathematics Concepts and Application, First Course, Van Engen et
Seeing Through Mathematics, Book 1, Special Edition, Van Engen et al.

Grade VIII: *Contemporary Mathematics 2*, Hanwell et al.
Exploring Modern Mathematics, Book 2, Keedy et al.
Mathematics Concepts and Applications, Second Course, Van Engen et al.
Seeing Through Mathematics, Book 2, Special Edition, Van Engen et al.

Grade IX: *Contemporary Mathematics 3*, Hanwell et al.
Exploring Modern Mathematics, Book 3, Keedy et al.
Seeing Through Mathematics, Book 3, Special Edition, Van Engen et al.

Note 1: *Mathematics Concepts and Applications*, First and Second Course, have been added to the list of recommended texts for Grades VII and VIII respectively effective September, 1971.

Note 2: *Seeing Through Mathematics*, Books 1 and 2, Special Edition, will be deleted from the list of recommended texts effective September, 1972 and September, 1973 respectively. Decisions relative to *Seeing Through Mathematics*, Book 3, Special Edition, will be made following further study of Grade IX mathematics materials.

Notes to Teachers Using the Different Recommended Texts

The comments below are designed to assist teachers in planning their programs from the various recommended texts. It must be emphasized that these notes are in no way prescriptive. They represent the collective opinion of a group of competent junior high school mathematics teachers who have had experience using the recommended texts.

Notes to Teachers Using the *Contemporary Mathematics* Series

The *Contemporary Mathematics* series has a Teacher's Edition for each grade level. The teachers using *Contemporary Mathematics* should note that, due to the order in which concepts are presented, they will have to adapt the course of studies to this series. Furthermore, if time permits at any grade level, it is suggested that more emphasis be placed on solving compound conditions in one variable and simple conditions in two variables.

Grade VII

The changes necessary in Grade VII involve leaving most of the set theory until Grade VIII and covering metric geometry more intensely in Grade VII. This section of geometry which includes measures of angles, calculation of perimeters, areas and volumes, and classifications of polygons is a necessary prerequisite for the geometry contained in the Grade VIII book.

Grade VIII

Leaving set theory until Grade VIII necessitates stress being placed on it at that time. Unit IX in Grade VIII should be covered almost entirely during the Grade VIII year because geometry is not contained in the Grade IX book. Fractional numbers and integers should be given very complete coverage in Grade VIII as rational numbers are not introduced until the Grade IX book. It may be wise, however, to give students some indication that fractional numbers may also be negative. Two topics not contained in the Grade VIII book are real numbers and polynomials. These topics are given adequate coverage in the Grade IX text.

Grade IX

In Grade IX rational numbers, real numbers and polynomials are introduced and given adequate coverage. Geometry should have already been covered in Grade VIII. By the end of the year all topics in the course of studies for Grades VII, VIII and IX should be covered. This means that teachers will find it necessary to use their own resources to present the concepts of direct and inverse variation and drawing line graphs and parabolas.

Notes for Teachers Using the *Exploring Modern Mathematics* Series

The *Exploring Modern Mathematics* series has available at each grade level a Student's Text and a Teacher's Edition. Programmed supplements are available for Grades VII and VIII.

The series is unique in having throughout the texts sets of discovery exercises which are intended to help the students discover the underlying mathematical concepts presented. However, these exercises, due to their complexity, are generally only suited to the superior mathematics students.

Throughout the series rigorous proofs are found. These proofs may be a challenge to the superior students, but due to their high level of difficulty are not considered appropriate for average and below average students.

Throughout the discussion below, it is occasionally indicated that the presentation of a required concept is considered to be too difficult in *Exploring Modern Mathematics*. It is expected that the teacher will use whatever other resources may be available to him, such as the other two recommended series.

Grade VII

1. Sets *Exploring Modern Mathematics* does not present enough material to coordinate the whole concept of sets and their relationships under various situations. Concepts related to sets not presented in *Exploring Modern Mathematics*, for example, are:

   a) that the empty set is a subset of all sets
   b) finite and infinite sets
   c) identical sets.

2. Whole Number System All concepts are well covered. There are plenty of "Let's Explore" exercises to enable students to study the concepts presented.

3. Factors and Multiples This chapter has presented some difficulty for average a below average students.

4. Fractional Numbers The method used in the Operation of Fractions is different, to students, from the method which has been presented to the vast majority of them in Grades V and VI in the *Seeing Through Arithmetic* texts. Therefore, it might be desirable for teachers to review these operations without particular reference to *Exploring Modern Mathematics*. *Exploring Modern Mathematics* presen a study of properties using fractions very well.

5. Rates, Ratio and Percent This area is poorly presented. The students who used *Seeing Through Arithmetic* have been very well trained in the use of ratio in solving percentage problems. *Exploring Modern Mathematics* reverts to the conventional method, often resulting in some confusion.

6. Geometry The geometry concepts are well correlated with the program of studies.

Grade VIII

1. Geometry Topics 1, 2 and 3 in the course outline are dealt with in depth in *Exploring Modern Mathematics*, Book 1, and only passing comments are made in Boo 2. The triangle, including classifications, perimeters and the sum of the angle is also found in Book 1. Areas of triangles, quadrilaterals and circles are found in Book 2 also, but are dealt with inadequately, in that the formulae developed rely too heavily upon the concept of sweeps. Alternate methods of finding area formulae should be explored.

2. Rational Numbers *Exploring Modern Mathematics* explores this topic from a very sophisticated point of view with text material requiring a reading level often higher than that of the average Grade VIII student. The book moves too quickly into difficult operations with integers and makes no use of the concept of directed numbers. The "Let's Explore" exercises tend to be too obvious and bright students are bored with them; or they tend to be too difficult so that most students do not develop the concepts intended. The above comments notwithstanding, the section on rational numbers is good, but needs supplementary material.

3. Conditions or Equations Solving equations and drawing graphs of their solutions is well presented but the book supplies very few problems involving equations.

4. Real Numbers
   a) Real numbers are not dealt with at all in Book 2 but are covered in Book 3.
   b) Polynomials in One Variable appear to be adequately treated in Book 2.
   c) Extension of Geometry. The only topic in this section that Book 2 treats is the Pythagorean Theorem, the general proof of which is presented at a very sophisticated level and is difficult to understand.

Grade IX

1. Variation The topic of variation is dealt with as an example of mathematical relationship that can be applied to many physical situations. Similar triangles are used to prove that the graph of an equation of direct variation, $y = kx$, is a set of points that lies on a line containing the origin. The graph of an equation, $y = kx + b$, is shown as a line parallel to the graph $y = kx$. The graph of a parabola is dealt with very briefly.

A casual approach is taken to an awareness of business and science formulae. Interest problems, and profit and loss problems are extensions of similar problems found in Book 2. Motion, work, lever and mixture problems follow one another too quickly. The torque law is used for lever problems but the other types are not solved by formulae. Few problems in the application of variation are included.

2. Geometry All nine points mentioned in Section C of the Grade VIII program of studies are adequately dealt with in *Exploring Modern Mathematics*.

3. Real Numbers Section D of the Grade VIII program of studies is not covered completely in *Exploring Modern Mathematics*. Order, completeness and density are not dealt with. Properties of real numbers are listed but very little is done to stress these because of their similarity to the properties of rational numbers. Considerable practice is given in working with real numbers in solving and graphing equations but little work in problem solving using real numbers is presented.

4. Extension of Polynomials With the exception of absolute value, these points are adequately dealt with. Here the two "cases" are not clearly distinguished, Nor is the fact that the absolute sign indicates an operation stressed. It is assumed that the student has experience with polynomials in one variable.

Notes to Teachers Using *Mathematics Concepts and Applications*, First and Second Course

Several kinds of ancillary materials are available to teachers using the texts *Mathematics Concepts and Applications*, First or Second Course. Such materials include:

Teacher's Edition
Practice Tablet
Teacher's Practice Tablet
Tests (on spirit duplicating masters)
Answer Books

Teachers using only the Grade VII or Grade VIII texts should be aware of the course of studies for both grades. Some topics listed in the **Program of Studies** as part of the Grade VIII program are introduced in the Grade VII book, particularly some sections on geometry. These topics are best treated during the Grade VII year.

The sequence of topics in either the course of studies or in the textbooks need not be the sequence used by teachers during the school year. In addition, all topics in the chapters listed below need not be included in the program for any given class. Teachers using either of the texts chapter by chapter and page by page will find the program to be much too long and much too difficult for many students. Selection of content and exercises from the text is necessary.

Grade VII

"Looking Back" sections in this text give an excellent review of the past year's work. These sections are found at the back of the text and the extent of their use will depend on the needs of the class. These needs can be diagnosed by the "Beginning of the Book" tests.

1. Sets Adequate coverage in Chapter 5.

2. Whole Number System Well covered in Chapter 5 with the exception of properties which should be supplemented with additional examples.

3. Factors and Multiples Good coverage in Chapter 6.

4. Fractional Numbers Good coverage in Chapters 4, 10, 11 and 12.

5. Rates, Ratios, and Percent Well covered in Chapters 7 and 14.

6. Geometry Covered in Chapters 4 and 8. Note: Though use of the protractor is included in the Grade VIII program of studies, it is suggested that the topic be taught here.

7. Problem Solving Chapters 7 and 13 cover general problem solving. Problem solvin however, is also included in other chapters.

Grade VIII

Again there is an excellent review of the Grade VII material which appears at the end of the text in the "Looking Back" section. The amount of this material that should be covered can be determined by the "Beginning of the Book" tests.

1. Rational Numbers
   a) Integers - Well covered in Chapter 5. Teachers may want to refer back to Chapter 21 in the Grade VII text for an introduction.
   b) Rational Numbers - Well covered in Chapter 6.
   c) Exponents - Well covered in Chapter 7.

2. Conditions and Equations Introduced in Chapters 5 and 6. A teacher will have to supplement this with extra material as the introduction is much too rapid for mos students.

3. Geometry Found in Chapters 4 and 10. Some topics are missing in the text and should be supplemented by other material. Some topics are covered in the Grade VII text. Topics which are not covered are:

   a) Intersection of coplanar lines (parallel lines)
   b) Certain construction problems such as bisection of angles, construction of perpendiculars, and construction of parallel lines. Comparison of metric and British systems of measurement are found in Chapter 9.

4. Two of the three topics listed in the Program of Studies should probably be covered. They are:

   a) Real Numbers (Chapter 8)
   b) Extension of Geometry (Chapter 14).

   Both of these topics are adequately covered in the text.

Notes to Teachers Using the *Seeing Through Mathematics* Series

In conjunction with each textbook of the *Seeing Through Mathematics* series the publishers have prepared a Teaching Guide and a Response Verification Book. In the Teaching Guide, the background concepts, the overall purpose of each lesson and teaching suggestions are presented. The Response Verification Book gives the expected replies and answers to all the questions asked in the lesson development and in the exercises and it has been found most helpful to those students who have been absent or who have had difficulty with a particular lesson. All teachers would be well advised to obtain these publications and refer to them regularly.

No single form of presentation is best for all teachers, all classes or all topics. The Teaching Guide does suggest that in most instances the students will be able to read the development exercises and discover the concepts for themselves with little assistance from the teacher. The apparently high reading level of the series seems to make this approach impractical except for the above average students and experience indicates that even these students find it tedious and soon lose interest. Many teachers found that they most often used the pupil-teacher interaction type of lesson in which the discussion followed the development suggested in the text.

The *Seeing Through Mathematics* program uses many symbols not employed in traditional texts and is highly sequential and for these reasons, extreme caution should be used if the order of presentation is changed. As has already been stated there is no need to follow the order of the topics as they appear in the Program of Studies.

Grade VII

Units I and II could be treated in their entirety but the extent to which the concepts are developed is left to the discretion of the teacher.

For classes of low ability or in those cases in which the teacher thinks adequate treatment will not be possible because of the time available, the solving of compound conditions in two variables and the problems that lead to such conditions could be postponed until Grade VIII, when in Unit IX, Lessons 111 to 119, or in Unit XI, Lessons 156 to 159, compound conditions using the real numbers are introduced. This would mean that Lessons 36, 38, 39 and parts of 40, Unit III, Lessons 47 and part of 48, Unit IV, and parts of Lessons 93 and 95, Unit VII, could be omitted from the Grade VII course.

The topics in Unit V are not part of the program of studies and all chapters could be omitted except for Lesson 53 which deals with factors, powers and exponential notation, and Lesson 57 which extends the decimal system.

The development of the whole or natural number system in Unit VI could be toned down in depth and rigor to a considerable extent without detracting greatly from the understanding of the basic ideas presented. Lesson 67 on finite number systems could be omitted.

At least nine weeks have generally been required for the coverage of Unit VII on fractional numbers. This amount of time could be reduced if the teacher has maintained the computational skills in fractions the students gained in Grades V and VI by giving drill exercises at regular intervals throughout the year.

Grade VIII

In Units VIII and IX, the text follows closely the Grade VIII program of studies in geometry except that the circumference and area of a circle, the Pythagorean Theorem and the surface area and volume of prisms, cylinders, cones, pyramids and spheres are postponed until Book III. If it has been decided that Unit XII is not to be covered, following Lesson 124, Unit IX, on congruent triangles, Lesson 164, Unit XII, on similar triangles could be inserted, to be followed by Lesson 125, Unit IX, and so on.

The remarks made regarding compound condition in two variables in Book 1 could be repeated here as it may be desirable to postpone the topic until Unit XI, Lessons 156 to 159. If such be the case, then Lessons 111, 115 and parts of 116, 117, as well as all of Lesson 118 could be omitted.

The rational numbers are introduced in Unit X using directed segments. However, in Lessons 131 and 133, the treatment becomes quite formal and teachers may wish to spend more time consolidating the ideas in Lesson 130 "Preparation for Addition" and Lesson 132 "Preparation for Multiplication" rather than in developing the definition of addition and multiplication as found in Lessons 131 and 133. The lack of rigid definition of the two operations will necessitate a more direct and simpler approach to the properties as found in Lessons 135, 136, 138 and 139 but the essential ideas found in these lessons can still be discussed with the students.

The section on compound conditions in two variables in Unit XI will require careful treatment if the earlier development of this topic has been omitted.

Unit XII will be an optional unit and Unit XIII has usually been postponed until Grade IX as it also appears in Book III in the special edition.

Grade IX

There should be ample time to cover the topics listed in the program of studies for Grade IX. Most classes should study only the materials as outlined in the program of studies; consequently, certain units and lessons in the text can be deleted. In Unit XIII, Lessons 170 and 171, which consider conditions of the type $y = \frac{k}{x}$ and $y = \frac{k}{x^2}$ and give rise to hyperbolas and two-part curves could be omitted.

The topics in Unit XV are an integral part of the course and treat the material presented in Part IV, Section C "Extension of Geometry" in the Grade VIII program of studies.

Unit XVI is not essential but Lessons 205 and 206 could serve as a review of the four operations involving rational numbers.

The understanding of the real numbers that began in the Grade VIII program is extended in Unit XVII. Lesson 213 "A Finite Field" and Lesson 217 "Indirect Proof" could be omitted without serious consequences.

Unit XVIII "Logic and the Nature of Proof" is also an optional unit.

Formal algebra is introduced in Unit XIX and when this unit is completed, the student should have gained an understanding and skill that will provide for future progress in algebra. However, additional exercises to those provided in the text will be required in most lessons and for most classes and the other recommended texts are a good source. Lesson 242 "A Comparison of Integers and Polynomials" and Lessons 248 "Principal Roots and Rational Powers" and 249 "Algebraic Expressions" could be omitted.

Unit XX should be included in the program as it deals with linear conditions and conditions that involve absolute value.

Units XXI and XXII are optional according to the Program of Studies.

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